DOCUMENT RESUME

ED 167 389 SE 025 303

AUTHOR Manley, Barry Lee
TITLE The Relationship of the Learning Environment to Student Attitudes Towards Chemistry.
PUB DATE 78
NOTE 20p.; Paper presented at the annual meeting of the National Association for Research in Science Teaching (51st, Toronto, Canada, March 31-April 2, 1978); Contains occasional light type

EDRS PRICE MF-$0.83 HC-$1.67 Plus Postage.
DESCRIPTORS *Achievement; *Attitudes; *Chemistry; Curriculum; Educational Research; *Learning Processes; Low Ability Students; Science Course Improvement Project; Science Education; Secondary Education; *Teacher Behavior

ABSTRACT

Examined was the problem of the learning environment as it related to differential affective outcomes. Two specific questions were investigated. First, were there overall significant differences in the learning environments of classes who scored high (the top 25% strong attitudes towards chemistry) on the Student Opinion Survey in Chemistry? Secondly, what was the exact nature of the differences in the classroom learning environments for these two groups? The sample consisted of 80 Interdisciplinary Approaches to Chemistry (IAC) classes. Two instruments were used to provide data for the study: the Student Opinion Survey in Chemistry (SOSC); and a modified version of the Learning Environment Inventory (LEI). The study found several significant differences in the learning environments of students scoring in the top, as opposed to the bottom, 25% on the SOSC. The results also suggested that the learning environment influenced affective responses and that the teachers' behavior in interpreting the curriculum was more important in determining student attitudes than were the IAC curriculum materials themselves. (Author/GA)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED167349

U.S. DEPARTMENT OF HEALTH, EDUCATION & WELFARE
NATIONAL INSTITUTE OF EDUCATION

THIS DOCUMENT HAS BEEN REPRODUCED EXACTLY AS RECEIVED FROM THE PERSON OR ORGANIZATION ORIGINATING IT. POINTS OF VIEW OR OPINIONS STATED DO NOT NECESSARILY REPRESENT OFFICIAL NATIONAL INSTITUTE OF EDUCATION POSITION OR POLICY

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Barry Hayley

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC) AND USERS OF THE ERIC SYSTEM."

THE RELATIONSHIP OF THE LEARNING ENVIRONMENT TO STUDENT ATTITUDES TOWARDS CHEMISTRY

Barry Lee Manley

Coventry School System

51st Annual Meeting of the
National Association for Research in Science Teaching
Toronto, Canada
March 31 - April 2, 1978

SE 025 303

INTRODUCTION

In 1973, the Chemistry Associates of Maryland, in conjunction with Harper and Row, published a new chemistry course called Interdisciplinary Approaches to Chemistry (IAC). The major design goal of the program was ". . . to stimulate and sustain the student's interest in chemistry and in studying science, regardless of the student's education or career goals" (Heikkinen, 1973, p. 4). A comparative experimental study, conducted in 1973 by Henry Heikkinen, was intended to provide evidence of the success of the IAC Curriculum Project in achieving its affective design goals. Surprisingly, the results of this study revealed that students using the IAC materials were not significantly different in attitude from those students using a traditional chemistry program.

The underlying assumption of the study by Heikkinen was that only the influence of the innovative curriculum produced differences in scores of students on the criterion instrument. This assumption implied that there existed in the school such things as "innovative" and "traditional" curriculum presentations. It also suggested that the teacher's actions or behavior in presenting and interpreting the curriculum had negligible effects on student cognitive and affective outcomes when compared with the effects of the curriculum materials themselves. This assumption has remained largely unchallenged.

A new research technique, not usually associated with curriculum evaluation, called a classroom interaction or learning

environment study, has raised serious questions concerning the validity of this assumption. Results indicate that, contrary to what had been assumed by Heikkinen and other researchers using curriculum comparison studies, innovative or traditional curriculum presentations, as such, do not exist in the classroom. Rather, each teacher presents his own interpretation or version of the curriculum. Gallagher (1966) reported that different teachers, using the same curriculum materials, had different goals and objectives, used different instructional strategies, and exhibited different patterns of emphasis.

Researchers, in failing to include information on classroom interaction as part of their experimental comparative studies, have overlooked many important variables which have potential significance for understanding student affective achievement; moreover, they have not obtained an accurate or complete picture of the effects of innovative curriculum on student outcomes.

This study examined the relationship of ten measures of perceived classroom behavior to student attitudes towards chemistry. The study was designed to answer two important questions. First, were there overall significant differences in the behavior profiles or learning environments of IAC classes that scored high on the Student Opinion Survey in Chemistry (SOSC), (within the fourth quartile deviation or top 25%) and those IAC classes that scored low on the SOSC (within the first quartile deviation or bottom 25%). Secondly, what was the exact nature of the differences in the classroom learning environment for the two

groups (Q_1 and Q_4).

PROCEDURES

Sample

Harper and Row, (publishers of IAC), provided a list of 85 New England high schools offering the IAC Chemistry program. Early in October, 1975, a letter was sent to the Science Department Chairperson in each school inviting his/her participation in the study and explaining the nature and purpose of the research. The chairperson was asked to supply the name of one IAC faculty member in his/her department who would be willing to participate in the research project.

Each faculty member recommended by the department chairperson was contacted by letter. Affirmative replies were received from faculty members of 33 schools (representing 81 full-year IAC classes). Test results were received from 80 out of the 81 IAC classes. The final sample consisted of 1,585 pupils in grades nine, ten, eleven, and twelve, in 80 full-year IAC classes distributed throughout five states: Connecticut, New Hampshire, Rhode Island, Massachusetts, and Maine.

Instruments

Two instruments were used in this study. The first instrument, a modified version of the LEI (Sainte-Marie, 1972), contained ten separate scales, each describing a different

characteristic of the learning environment. Each scale contained seven items. Specific reference to the teacher is omitted in the LEI. A student expresses agreement or disagreement on a four point Likert-type scale. Alpha reliability coefficients reported by Anderson (1973) for each LEI scale are presented in Table 1.

Table 1.

Alpha Reliability Coefficients for the LEI

LEI Scale	Alpha Coefficients	
	1967	1969
Cohesiveness	0.78	0.69
Diversity	0.58	0.54
Formality	0.64	0.76
Speed	0.77	0.70
Environment	0.65	0.56
Goal-direction	0.86	0.85
Favoritism	0.77	0.78
Cliqueness	0.74	0.65
Difficulty	0.66	0.64
Competitiveness	0.78	0.78

The second instrument used in this study, the Student Opinion Survey in Chemistry or SOSC, was developed and pilot-tested by Dr. Henry Heikkinen of the University of Maryland and provided data on class attitudes towards chemistry. On a five point scale ranging from "strongly agree" to "strongly disagree", students were asked to indicate their response to 20 statements, representing different opinions they might have about studying chemistry. The

instrument contained ten favorable and ten unfavorable items randomly ordered. Student attitude scores ranged from a maximum favorableness of 100 (20 x 5) to a maximum unfavorableness of 20 (20 x 5), with neutral opinions earning a score of 60 (20 x 3). Technical characteristics of the SOSC include: consistency as measured by Chronbach Alpha greater than .90; reliability of tests on test-retest basis r=.83. All of the items on the SOSC discriminate successfully between the high (upper 27%) and low (lower 27%) individuals in terms of overall SOSC scores (Heikkinen, 1973).

Experimental Design

Alpha Reliability Coefficients and Guttman split-half Coefficients were computed for the SOSC and for each subscale on the LEI, using the SPSS sub-program for reliability developed by Specht (1973). Scale means, standard deviations and frequency tables of school grade, student sex, intention to attend college, and ability level were computed for the entire sample. The presence of overall significant differences in the learning environments of classes that scored high (in the fourth quartile or top 25%, strong attitudes towards chemistry) and low (in the first quartile or bottom 25%, weak or neutral attitudes towards chemistry) on the Student Opinion Survey in Chemistry, was tested using a two group discriminant analysis. IAC classes were selected from the two extremes of the distribution of attitude

scores (Q_1 and Q_4) in order to maximize the chances of discovering differences in the learning environments. The nature of specific differences between the learning environments of the two groups (Q_1 and Q_4) were determined using the univariate F statistic which the discriminant analysis produced. The unit of analysis used was the class mean. Standardized discriminant function coefficients were produced as part of the discriminant analysis and were used to provide a measure of the relative importance of each LEI scale as a discriminator between the two groups (Q_1 and Q_4).

RESULTS

Instrument Reliability

The Alpha Coefficients and Guttman Split-half Coefficients were computed for the SOSC and each subscale of the LEI using the reliability program developed by Specht (1973). The results are summarized in Table 2 below.

Table 2.

Reliability Coefficients for the LEI and SOSC

LEI Scale	Alpha Coefficients	Guttman Split-half Coefficients
Cohesiveness	0.6778	0.7142
Diversity	0.5611	0.4190
Formality	0.6528	0.4916
Speed	0.7789	0.7905
Environment	0.6044	0.5306
Goal-Direction	0.8420	0.7878
Favoritism	0.7728	0.7379
Cliqueness	0.6671	0.6216
Difficulty	0.6847	0.6694
Competitiveness	0.7807	0.7444
SOSC	0.9565	0.9471

The obtained values compared very closely with reliability coefficients reported by Anderson (1973) and Heikkinen (1973). The table indicates that the instruments were dependable and substantial amounts of the test variance could be attributed to the principle factors measured by the LEI and SOSC (perceptions of the learning environment and student attitudes respectively).

Multivariate Results

The presence of an overall significant difference in the learning environments for the two groups (Q_1 and Q_4) was tested using a two group discriminant analysis. The .05 level of significance was adopted for the rejection of the null hypothesis. The results are summarized in Table 3.

Table 3.

Multivariate Results

Discriminant Function	Canonical Correlation	Wilks' Lambda	Chi-Square	DF	Decision
1	0.873	0.2380	47.372 sig.	10	.05 X = 18.31 2.10

The obtained value for the Chi-Square (47.372) with 10 degrees of freedom was significant at the .05 level. The conclusion was reached that the overall learning environments for the two groups (Q_1 and Q_4) were significantly different.

Univariate Results

The nature of specific differences between the learning environments of the two groups was determined using the univariate F statistic produced as part of the discriminant analysis. The .05 level of significance was adopted for the rejection of the univariate null hypotheses. The univariate results are summarized in Table 4.

Table 4.

Univariate Results

LEI Scale	Null Hypothesis $u_{Q_4} - u_{Q_1} = 0$	Decision .05 F = 4.10 1.38	Univariate F Statistic	Predicted Direction	Outcome of Prediction	Scale Means Q_1	Scale Means Q_4	Standardized Discriminant Function Coefficient
Cohesiveness	No difference	Accepted	1.6127	Q_4 Higher mean	Supported	19.1353	19.7258	0.27864
Diversity	No difference	Accepted	0.1896	Q_4 Higher mean	Contradicted	20.4052	20.3286	0.06174
Formality	No difference	Accepted	0.7271	Q_4 Higher mean	Supported	18.9717	19.3535	0.25499
Speed	No difference	Rejected	12.7457	Q_4 Lower mean	Supported	18.4832	16.4408	0.24858
Environment	No difference	Rejected	27.1442	Q_4 Higher mean	Supported	17.9939	20.1268	0.21969
Goal-Direction	No difference	Rejected	30.8603	Q_4 Higher mean	Supported	16.2119	18.8917	0.29333
Favoritism	No difference	Rejected	30.4079	Q_4 Lower mean	Supported	14.8493	12.6522	-0.23725
Cliqueness	No difference	Accepted	0.2231	Q_4 Lower mean	Contradicted	18.5589	18.7668	0.20228
Difficulty	No difference	Rejected	30.5814	Q_4 Lower mean	Supported	20.6611	18.4633	-0.62008
Competitiveness	No difference	Accepted	0.3079	Q_4 Lower mean	Supported	17.0884	16.8748	0.17660

INTERPRETATIONS

This study was designed to determine whether there were overall significant differences in the learning environments of IAC classes who scored high on the SOSC (within the fourth quartile deviation or top 25%, strong attitudes towards chemistry) and those who scored low (within the first quartile deviation or bottom 25%, weak or neutral attitudes towards chemistry). Secondly, it attempted to determine as precisely as possible the nature of the differences between the learning environments of the two groups. The Chi square computed for the multivariate analysis was significant and indicated that the overall learning environments (concerning all ten LEI scales concurrently) for the two groups were significantly different. These multivariate results support previous findings by Gallagher (1966) and Rosenshine (1970), regarding variation in teacher behavior within a single curriculum. They suggest that the teacher's behavior and actions in presenting and interpreting the IAC curriculum have far more important effects on student affective outcomes than the IAC curriculum materials themselves.

The results of the univariate analyses revealed significant differences in student perception on five of the ten LEI scales. Students in classes scoring in the fourth quartile (top 25%) perceived their classes as having a significantly slower rate of progress. These findings suggest that the teacher has successfully adapted his rate of instruction to the pace of the class. This finding supports previous research by Walberg (1969) and suggests

that, when the rate of instruction is adapted to the pace of the class, attitudes towards chemistry are more positive. Speed was ranked fifth (based on the value of the standardized discriminant function coefficient) in relative importance as a discriminator between the two groups.

The physical environments for the two groups (Q_1 and Q_4) were significantly different. The findings suggest that attractive, well-organized, physical environments, in which books and equipment are accessible to the students, promote more positive attitudes towards chemistry. Students in the fourth quartile (top 25%) viewed their classes as having a significantly better physical environment. These findings support previous research by Gardner (1976) in which he reported that teachers who were highly achievement-oriented, cognitively well-organized, intellectually stimulating, and whose classroom environments were physically well-organized, were associated with more positive attitudes towards physics. The results imply that the teacher is interested in communicating and is aware of the potential impact of the physical environment on student interest and motivation.

On the basis of the standardized discriminant function coefficient (+.29), goal-direction was ranked second in relative importance as a discriminator between the two groups. Moreover, students in the high group perceived their classes as significantly more goal-directed. Results suggest that the teacher has been successful in communicating a sense of direction and purpose and

that the students have identified with the learning goals of the class. Furthermore, the results suggest that attitudes towards chemistry are more positive in classes where: goals are not ambiguous, class goals are perceived to be meaningful, goals are clearly understood, the goals are achieved by clearly required steps, and students are kept informed about their rate of progress.

As expected, students in the fourth quartile experienced significantly less favoritism. The standardized discriminant function coefficient for the favoritism scale was -.24. The negative sign indicates that favoritism is inversely related to student attitudes towards chemistry. The more favoritism that is shown, the more negative student attitudes become. Students treated fairly in class, receiving the same attention and recognition, and enjoying the same privileges, have more positive attitudes towards chemistry.

The difficulty scale was the discriminating variable that most adequately distinguished between the two groups. The value of the standardized discriminate function coefficient for the difficulty scale was -.62. As predicted, students in the fourth quartile viewed their classes as significantly less difficult. Attitudes towards chemistry are more positive in chemistry classes that are perceived to be clearly presented, well-organized, and therefore, less threatening. The findings suggest that the teacher is aware of mathematical and reading deficiencies and has planned and provided alternate learning experiences through which each

student can enjoy a large measure of success. Teachers whose classes scored in the fourth quartile, interviewed by phone after the study was completed, spoke about their efforts to change a subject usually defeat-oriented and boring, requiring little student involvement and interaction into a subject in which the emphasis was on student activity and participation and in which each student could enjoy a large measure of success.

The two groups were not significantly different in cohesiveness, despite the fact that the cohesiveness scale was ranked third (+.28) in relative importance as a discriminator between the two groups. The discriminant analysis, in ranking the LEI scales according to their ability to discriminate the two groups, takes into consideration the intercorrelation between each LEI scale. This intercorrelation is not accounted for in the univariate F statistic. The direction of the prediction was correct, however, indicating that students in the high group did perceive their classes as having a higher degree of intimacy. These findings suggest that attitudes are more favorable in classes that provide opportunity for student contact and interaction.

Students with the most positive attitudes perceived their classes as being more formal (non-significant). The mean on this scale for the entire sample compared very closely with a mean (19.29) recorded by Anderson (1973) for ten chemistry classes from the Metropolitan area of Montreal. The findings suggest that chemistry classes generally are perceived as being quite formal,

with rules and policies governing classroom behavior established and enforced.

There was no significant difference between the two groups on the competitiveness scale. As predicted, the direction (less competitive) was in favor of the high group. Gardner (1976) reported greater enjoyment of physics by lower-achieving students in a class which is low on the variable competitiveness. He reported very high achieving students maintain more positive attitudes in classes rated very high in competitiveness. The competitiveness scale was ranked very low (ninth) in its relative ability to discriminate between the two groups. The findings suggest that student attitudes towards chemistry are more positive in a learning environment in which class members cooperate with each other than vie with one another for grades and recognition.

The sample mean for the diversity scale was the highest mean reported for the sample, although students in the higher group perceived their classes as being somewhat less diverse. Moreover, the magnitude of the sample mean suggests that the IAC curriculum, because of its modular design and contemporary emphasis, appealed to students with a wide range of science interest. The findings support previous research by Anderson (1971) which indicated that science classes generally are perceived as being more diverse when compared with mathematics and humanities classes.

The null hypothesis in the case of the cliqueness scale was supported. The direction on this scale, however, was opposite

to that predicted. That is, students in the fourth quartile viewed their classes as having more cliqueness than classes scoring in the first quartile. The cliqueness scale ranked eighth in relative importance as a discriminator between the two groups. It is not clear to the investigator why cliqueness would be higher in the high group. Perhaps, as Anderson (1968) suggests, the sub-groups may represent the "cabal variety" of clique designed to help certain groups of students to succeed in chemistry. The cliques may also provide security (Bates, 1974) for students who find chemistry particularly threatening. Anderson (1971) reported that science classes generally are perceived as lacking cliqueness when compared with mathematics and humanities classes. In the final analysis, however, the results with respect to cliqueness are inconclusive.

SUMMARY AND IMPLICATIONS

The major conclusions of this study can be summarized as follows:

1. The Chi square computed for the multivariate analysis was significant and indicated that the overall learning environments (considering all ten LEI scales concurrently) for the two groups (Q_1 and Q_4) were significantly different.

2. Several important and significant differences were found in the learning environments of students scoring in the first as opposed to the fourth quartile on the SOSC. Students

who had the most positive attitudes towards chemistry viewed their classes as being significantly less difficult, having a significantly slower rate of progress, a significantly better physical environment, being significantly more goal-directed, and having significantly less favoritism.

3. The results suggest that the learning environment does influence affective response and the teachers' behavior in interpreting the curriculum is considerably more important in determining student attitudes than the IAC curriculum materials themselves.

4. Since these important findings would have been overlooked in a traditional curriculum comparison study, classroom interaction studies should be included as an important and integral part of any curriculum evaluation program.

5. Since the successful implementation of new (or existing) science curriculum projects depends to a large extent on the teacher's behavior and influence (rather than on the influence of the curriculum materials themselves) it is important that school systems budget monies for faculty training and consultant help. The cognitive and affective design goals of new (and existing) science programs will never be achieved unless ". . . the teacher is brought to full understanding of the objectives, and is also encouraged and supported in his efforts to transform these objectives into real life actions in the classroom" (Sainte Marie, 1972, p. xi).

6. In science education workshops (inservice as well as summer periods of instruction) special attention should be given to the following topics: adapting the rate of instruction to the needs of the class, goal formation, improving the physical environment, the fair and equitable treatment of students and instructional strategies that make it easier for students to understand and acquire difficult concepts.

7. Finally, it is important that school systems establish a curriculum evaluation program to monitor the implementation and progress of new (and existing) science curriculum projects. Actual observations of classroom behavior should be recorded as part of the evaluative process and should be examined in reference to student cognitive and affective outcomes. Information provided by such an evaluation program could be used by science supervisors, science coordinators and other administrative personnel for the assessment of teacher effectiveness with respect to the affective and cognitive design goals of the science program.

REFERENCES

Anderson, Gary J. Effects of Classroom Social Climate on Individual Learning. Unpublished doctor's thesis. Cambridge: Harvard University, 1968.

_____. "Effects of Course Content and Teacher Sex on the Social Climate of Learning." American Educational Research Journal, 1971, 8, 4, 649-663.

_____. A Manual for the Learning Environment Inventory and My Class Inventory. Halifax, 1973.

Bates, Gary. Predicting Learning Environments from Teacher and Student Personality. Unpublished doctor's thesis. Cambridge: Harvard University, 1974.

Gallagher, James J. "Teacher Variation in Concept Presentation in BSCS Curriculum Program." Urbana: Institute for Research on Exceptional Children, Univ. of Illinois, 1966.

Gardner, P.L. "Attitudes Toward Physics: Personal and Environmental Differences." Journal of Research in Science Teaching, 1976, 13, 2, 111-125.

Heikkinen, Henry. Attitude Assessment in IAC. Paper presented to the NSIA Regional Convention, November 1973, Norfolk, Va. (Mimeograph).

_____. "A Study of Factors Influencing Student Attitudes Towards Chemistry." Unpublished doctor's thesis. University of Maryland, 1973.

Rosenshine, Barak. "Evaluation of Classroom Instruction." Review of Educational Research, 1970, 40, 279-301.

Sainte-Marie, Louis. Effects of a Flexible Approach to High School Physics on Classroom Climate. Unpublished doctor's thesis. Cambridge: Harvard University, 1972.

Specht, David A. SPSS: Statistical Package for the Social Sciences - Users Guide to Subprogram Reliability. Ames: Iowa State University, 1973.

Walberg, Herbert J. "Social Environment as a Mediator of Classroom Learning." Journal of Educational Psychology, 1969, 60, 443-448.